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# LT 3

PATRIMONIO Y  
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## HERITAGE AND REHABILITATION / PATRIMONIO Y REHABILITACIÓN

- p. 565-574: **NEW KNOWLEDGE ABOUT THE CHURCH OF SANTA MARÍA IN CARMONA** / p. 575-585: **NOVEDADES EN TORNO A LA IGLESIA DE SANTA MARÍA DE CARMONA**  
Ojeda Barrera, Alfonso
- p. 587-596: **GEOMETRY AND CONSTRUCTION THROUGH THE SACRED SPACE OF ANDRÉS DE VANDELVIRA** / p. 597-607: **GEOMETRÍA Y CONSTRUCCIÓN A TRAVÉS DEL ESPACIO SACRO DE ANDRÉS DE VANDELVIRA**  
Estepa Rubio, Antonio
- p. 609-619: **AN APPROACH TO THE IDEAL CONCEPT OF URBAN PLANNING IN THE 18TH CENTURY: COLONIAL SETTLEMENTS IN ANDALUSIA** / p. 620-630: **APROXIMACIÓN AL URBANISMO IDEAL EN EL S. XVIII: LAS NUEVAS POBLACIONES DE COLONIZACIÓN EN ANDALUCÍA**  
Quevedo Rojas, Carlos
- p. 631-642: **POWER PLANT REUTILIZATION STRATEGIES ENEL POWER PLANTS AND PORT OF GENOA CASE-STUDY** / p. 643-655: **ESTRATEGIAS DE REÚSO DE LAS CENTRALES ELÉCTRICAS. LAS CENTRALES ENEL Y EL CASO ESTUDIO DEL PUERTO DE GÉNOVA**  
Olivieri, Davide
- p. 657-664: **TECHNICAL-TECHNOLOGICAL AND MATERIALS COMPARATIVE ANALYSIS BETWEEN ITALIAN AND SPANISH MEDIEVAL SHIPYARD (THE CASE OF VENICE AND SEVILLE)** / p. 665-673: **ANÁLISIS COMPARATIVO TÉCNICO-TECNOLÓGICO Y DE MATERIALES ENTRE LOS ASTILLEROS MEDIEVALES ITALIANOS Y ESPAÑOLES (LOS CASOS DE VENECIA Y SEVILLA)**  
Debenedictis, Domenico; Robador González, María Dolores; Pagliuca, Antonello
- p. 675-684: **STRATEGIES FOR CONSERVATION OF RELIGIOUS HERITAGE IN THE METROPOLITAN AREA OF LYON/SAINT-ÉTIENNE (FRANCE). SHORT RESEARCH STAY AND METHODOLOGICAL TRANSFER** / p. 685-695: **ESTRATEGIAS PARA LA CONSERVACIÓN DEL PATRIMONIO ECLESIAÍSTICO EN LA METRÓPOLIS LYON/SAINT-ÉTIENNE (FRANCIA). LA ESTANCIA BREVE INVESTIGADORA COMO VÍA DE TRANSFERENCIA METODOLÓGICA**  
Mascort-Albea, Emilio J.; Meynier-Philip, Mélanie
- p. 697-709: **HYDRAULIC HERITAGE AND THE CONSTRUCTION OF THE TERRITORY: THE IRRIGATION COMMUNITIES** / p. 710-722: **EL PATRIMONIO HIDRÁULICO EN LA CONSTRUCCIÓN DEL TERRITORIO: LAS HEREDADES**  
Delgado Quintana, Guacimara
- p. 723-731: **SUSTAINABILITY AND CONSERVATIVE REHABILITATION OF EXTREMADURAN PATRIMONIAL RURAL ARCHITECTURE AGAINST CLIMATE CHANGE. VEGAVIANA, CASE STUDY** / p. 732-741: **SOSTENIBILIDAD Y REHABILITACIÓN CONSERVADORA DE LA ARQUITECTURA RURAL PATRIMONIAL EXTREMEÑA CONTRA EL CAMBIO CLIMÁTICO. VEGAVIANA, CASO DE ESTUDIO**  
Bote Alonso, Inmaculada
- p. 743-754: **TOWARDS A METHODOLOGY FOR THE ASSESSMENT OF VISUAL IMPACT CAUSED BY RENEWABLE ENERGY FACILITIES ON THE LANDSCAPE IN CULTURAL HERITAGE SITES** / p. 755-766: **HACIA UNA METODOLOGÍA DE VALORACIÓN DEL IMPACTO VISUAL CAUSADO POR INSTALACIONES DE ENERGÍA RENOVABLE EN EL PAISAJE EN EL ENTORNO DE LUGARES PATRIMONIO CULTURAL**  
Diego Rodríguez, Jesús Carlos; Chías Navarro, Pilar
- p. 767-772: **THE URBAN RENOVATION IN PUEBLA, MEXICO. THE HISTORICAL CENTER AS EXPERIMENTAL SPACE. THIRTY YEARS OF CITY TRANSFORMATION** / p. 773-779: **LA RENOVACIÓN URBANA EN PUEBLA, MÉXICO. EL CENTRO HISTÓRICO COMO ESPACIO EXPERIMENTAL. TREINTA AÑOS DE TRANSFORMACIÓN DE LA CIUDAD**  
Cortés Moreno, Jorge David
- p. 781-790: **THE ORNATE IN THE ARCHITECTURE OF TENERIFE AND GRAN CANARIA: 1865-1935** / p. 791-800: **EL ORNATO EN LA ARQUITECTURA DE TENERIFE Y GRAN CANARIA: 1865-1935**  
Sabina González, José Antonio
- p. 801-807: **THE CONSERVATION OF THE CONSTRUCTIONS LOCATED ON PROTECTED NATURAL AREAS: RESEARCH EXPERIENCE IN DOÑANA** / p. 808-815: **LA CONSERVACIÓN DE LO CONSTRUIDO EN LOS ESPACIOS NATURALES PROTEGIDOS: EXPERIENCIA DE INVESTIGACIÓN EN DOÑANA**  
Rincón Calderón, José María; Galán Marín, Carmen; Sanchez Fuentes, Domingo
- p. 817-827: **TRANSHUMANCE HERITAGE IN THE STRUCTURING OF THE LANDSCAPE, CITIES AND ARCHITECTURE** / p. 828-838: **EL PATRIMONIO DE LA TRASHUMANCIA EN LA VERTEBRACIÓN DEL TERRITORIO, LA CIUDAD Y LA ARQUITECTURA**  
Gutiérrez Pérez, Nicolás
- p. 839-848: **INTERVENTION IN THE HERITAGE OF RURAL COLONIZATION ARCHITECTURE. THE VILLAGES OF LOS MONEGROS** / p. 849-859: **INTERVENCIÓN EN EL PATRIMONIO DE LA ARQUITECTURA RURAL DE COLONIZACIÓN. LOS POBLADOS DE LA COMARCA DE LOS MONEGROS**  
Prieto Mochales, Luis
- p. 861-870: **MODERN ARCHITECTURE IN MANZANILLO, COLIMA, MEXICO 1930-1970 (TRANSFER AND ADAPTATION)** / p. 871-880: **ARQUITECTURA MODERNA EN MANZANILLO, COLIMA, MÉXICO 1930-1970 (TRANSFERENCIA Y ADAPTACIÓN)**  
Yáñez Ventura, Marco Antonio; López García, J. Jesús
- p. 881-893: **FIRST INTERNATIONAL ARCHITECTURAL JOURNEY OF JUAN MADRAZO** / p. 894-906: **PRIMER VIAJE INTERNACIONAL ARQUITECTÓNICO DE JUAN MADRAZO**  
Fernández Martínez, Margarita María
- p. 907-918: **HOUSES, COURTYARD TENEMENT HOUSING, INNS AND SHOPS IN 16TH SEVILLE. ARCHITECTURE, DRAWING AND GLOSSARY OF MASTER BUILDERS** / p. 919-930: **CASAS, CORRALES, MESONES Y TIENDAS EN LA SEVILLA DEL SIGLO XVI. ARQUITECTURA, DIBUJO Y LÉXICO DE ALARIFES**  
Núñez González, María
- p. 931-939: **TOWARDS THE CONSTRUCTION OF ATLAS OF SURVIVING ARCHITECTURES** / p. 940-949: **HACIA LA CONSTRUCCIÓN DEL ATLAS DE ARQUITECTURAS SUPERVIVIENTES**  
Tejera Mujica, Noemi
- p. 951-960: **TRANSFORMATIONS OF THE ALCÁZAR OF SEVILLE THROUGH ITS IMAGES (1902-1969)** / p. 961-971: **TRANSFORMACIONES DEL REAL ALCÁZAR DE SEVILLA A TRAVES DE SUS IMÁGENES (1902-1969)**  
Bañasco Sánchez, Pablo
- p. 973-980: **THE ARCHITECTURE OF POWER. THE ISLAND INSTITUTIONS AND AUTONOMOUS BODIES. ANALYSIS OF THE CASES: GRAN CAÑARIA, TENERIFE AND MADEIRA** / p. 981-987: **LA ARQUITECTURA DEL PODER. LAS INSTITUCIONES INSULARES Y ORGANISMOS AUTÓNOMOS. ANÁLISIS DE LOS CASOS: GRAN CANARIA, TENERIFE Y MADEIRA**  
Hernández Cruz, Ricardo Kevin
- p. 989-998: **PROPOSAL FOR AN INDICATORS SYSTEM OF URBAN INTEGRATION OF THE MARITIME PORTS HERITAGE** / p. 999-1009: **PROPUESTA PARA UN SISTEMA DE INDICADORES DE INTEGRACIÓN URBANA DEL PATRIMONIO PORTUARIO MARÍTIMO**  
De las Peñas García, Jesús
- p. 1011-1020: **EMPIRICAL METHOD APPLIED IN RESEARCH ON RESIDENTIAL ENERGY RETROFITTING** / p. 1021-1031: **MÉTODO EXPERIMENTAL EN LA INVESTIGACIÓN SOBRE REHABILITACIÓN ENERGÉTICA RESIDENCIAL**  
Escandón, Rocío; Blázquez, Teresa; Martínez-Hervás, Mónica; Suárez, Rafael; Sendra, Juan José
- p. 1033-1042: **AESTHETICS OF RUINS AND ETHICS OF ARCHITECTURAL DESIGN: NEW INTERVENTIONS ON ARCHAEOLOGICAL HERITAGE** / p. 1043-1053: **ESTÉTICA DE LAS RUINAS Y ÉTICA DEL PROYECTO ARQUITECTÓNICO: NUEVAS INTERVENCIONES EN EL PATRIMONIO ARQUEOLÓGICO**  
Bagnato, Vincenzo Paolo

# PROPOSAL FOR AN INDICATORS SYSTEM OF URBAN INTEGRATION OF THE MARITIME PORTS HERITAGE

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**Abstract:** This article, which is part of a larger research project, aims to contribute to the development of tools to measure the level of urban integration of port heritage in maritime cities.

The indicators have been proposed on the basis of the concept of integration defined during the work, whose initial hypothesis underscores the importance of maintaining port activities in balance with more urban uses for the sustainability of the economic development of cities, in line with the notion of urban historical landscape. According to this tool of urban management, the concept of port heritage is redefined in this work and transcends its historical character to be incorporated in the urban heritage, preserving its functionality and its link with the port.

During the development of the work, the principle of integration has been narrowed from a strictly urbanistic approach, which has dealt with the aspects of urban geography and territory, spatial relations and mobility and functional relations of the port and city. These three dimensions, which make up the proposed integration model, have been defined through measurable variables, which group the resulting indicators that best express the phenomenon of urban integration of the port in maritime cities.

**Keywords:** Urban indicators; Urban integration; Sea port; Heritage; Cityscape

## 1. Introduction

This communication to the *I International Congress of Doctorates in Architecture of Seville* aims to present the results obtained to date in the definition of measurable variables of a theoretical concept, the urban integration of maritime port heritage, which allow its valuation through the use of indicators.

The results presented in this article is part of the research carried out at the International School of Doctorate of the University of Seville (EIDUS), whose thesis project approved by the Academic Commission of the PhD Program in Architecture under the title *Port Heritage in the Historical Urban Landscape of Cádiz*, focuses its objectives on port transformations in maritime cities, their relationships with the cultural landscape and the opportunities presented by the heritage of these ports as a tool for urban integration, and their application in the case concrete of the city of Cadiz.

It has been based on models of port development that have served as reference in the last decades, such as Bird's model *Anyport*, which describes the evolution of port facilities in time and space from its origin to its specialization with the emergence of containers (Bird C J, 1965). Hoyle's work complements the historical study of the spatial evolution of ports, adding to the factors and tendencies that interact in the recovery of waterfronts (Hoyle, 1989).

These transformations of the cities produced in the different stages, which have been differentiated by different authors, due to the specialization of their ports and their distancing from the city, usually result in a degradation of the maritime front of the cities in which obsolete spaces and facilities appear with little or no port activity. This phenomenon, accompanied by the alteration of the port-city relations that it entails, coincides in many aspects in all cases, but without a doubt, they manifest themselves in different degree according to each local context (López Amil C, 2004).

The lack of consideration of these singularities has led to the cloning of urban recovery intervention models characterized by actions that are treated as other degraded areas of the city, based on recomposition, requalification or recovery of these spaces for the city (Bruttomesso, 2004), without regard to the specificity of the site offered by the port.

The similarity of these models that have been reproduced since the middle of the last century allows distinguishing four historical stages. The first experiences occurred in American ports such as Boston or Baltimore during the 1960s, focused on the city's recovery of obsolete spaces and the implementation of new facilities for leisure and tourism outside the port. During the 1980s the pattern was subtly transformed for export to northern Europe, the case of London being the most representative model in which novelties were added such as the insertion of residential uses. Subsequently, the port front takes center stage as the main image of the city in commercial operations

of attraction of markets during the celebration of international events, as happened during the nineties in Genoa or Barcelona. It is not until the early years of the present century that due importance has been given to the port identity of cities and to the opportunity to integrate port functions into the recovery operations of these spaces (Andrade Marqués and Blasco López J, 2012).

This model of urban integration as a new paradigm directly links the maintenance of the port's functions with a sustainable economic and social development of cities. In order to do this, it is necessary to re-read the activities of the port and its living heritage, in which historical heritage is accommodated from a less romantic approach (Chaparría, 2011). In this way, it will be possible to find meeting spaces between the city and the active port, and in the end, be able to manage the port heritage as part of the historical urban landscape, in terms of the new concept coined by the latest heritage theories.<sup>1</sup>

There are no known studies dealing with the measurement of the phenomenon of urban integration of seaports through the use of indicators that can monitor the impact of the actions in each local context. This work aims to start a path towards the objective knowledge of urban integration with the construction of measurement tools, which can complement the indicators of environmental sustainability that have been designed in other studies.

## **2. Objectives**

Although the research to which this article belongs is focused on the city of Cadiz, during its development have defined general strategies for action applicable to cities and seaports. In this way a concrete integration pattern could be achieved, based on case studies taken from existing publications. However, in view of the many possible actions and especially the local particularities of each case, the final results may show different incidence of each example (Casariego, 1999). This is why it is necessary that the proposals are accompanied by a follow-up of the development of the model that allows knowing the results and the level of integration achieved at each moment.

Based on the above, this work is presented whose objective is the formulation of a scheme of indicators to serve as a basis for measurement tools to assess the level of port-city integration in its urban dimension. In this way, instruments are obtained to know the initial situation with respect to the previously defined objectives and to be able to plan the actions, to follow up the results obtained from the decisions made, and finally, to have values referring to the same scale that allow the comparison of the level of integration with other ports under study.

## **3. Conceptual framework**

The specialization and management processes of the ports, together with the negative impacts that their activity produces on the environment and the negative image perceived by the citizen, are the main causes of the distance and physical and mental separation of the port, resulting in a spatial and functional organization of cities back to their port.

In this way, the facilities of the active port, or what for this work we will call the living port heritage, are disconnected from the urban structures and systems. Likewise, historical port heritage is not recognized as part of the urban heritage and is excluded from any patrimonial management policy.

Interventions on port fronts have generally been based on the transformation of these spaces and their return to the city, which entails in relation to the port, the displacement of the barrier that separates the two realities. In this way, the generalized idea among the population of port and city continues to be fed as two different entities (Casariego, 1999), in which, in this case, the city wins and displaces the port. Conversion operations usually go through urban profitability, if the use of tertiary uses prevails, or urban revitalization, when the morphological recomposition of the city with new facilities and public spaces is pursued (Grindlay Moreno, 2008), in some cases including promotion of new housing developments. In this way, in both cases, the port's footprint in the city disappears, reducing to the preservation of docks adapted to the mooring of sports boats or recreation, or to the maintenance of some testimonial element that once was part of the port.

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<sup>1</sup> This reconceptualization of historical centers was first coined in the 2005 Vienna Memorandum and redefined in the Urban Historic Landscape Recommendation of the Paris General Conference in 2011, which defines it as the urban area resulting from a historical stratification of values and cultural and natural attributes, which transcends the notion of set or historical center to encompass the general urban context and its geographical environment.

Currently, many professionals agree that the port's urban integration model must follow different lines of action with which the port is recognized as part of the urban landscape because of its importance as an economic engine and identity role (Bruttomesso, 2009). These tendencies seek the difficult coexistence of the port's own functions with the more traditional urban uses (Chapapriá, 2011). Thus, the port heritage, both living and historical, can be used as a tool to streamline the integration actions that are carried out.

However, in order to clarify the direction of this work, it is essential to specify the concept of integration, in the context of the new notion of urban historical landscape coined by UNESCO's letters and recommendations.

In a first search of the word *to integrate* in the Dictionary of the *Real Academia de la Lengua Española* we find several meanings, the first three meanings being the ones that are more adjusted to the context of this work. The first of them, *to construct a whole*, refers to the achievement of achieving something complete or finished; with the second definition: *to complete a whole with the parts that are missing*, one focuses on the idea of imperfection and on the importance of the elements that are necessary to correct it; Finally, *to make something become part of a whole*, it reinforces the value of the absent element that grants the whole of all parts the notion of totality.

Applying this idea to the field at hand, we must understand the whole as the environment or the natural environment in which the port is located, in most cases transformed by the action of man in cultural landscape, or in its category specific, in historical urban landscape.

This term of historical urban landscape is the result of a reconceptualization of the historical centers that treats the management of the heritage from a holistic perspective, with which they reconcile conservation of the patrimony with economic and social development of the cities, going beyond the city historical to encompass the natural environment in which it is related, and incorporating individual and collective perception into the urban fact (UNESCO, 2005).

In this way, with the use of this new heritage management tool, the port and its living heritage, traditionally considered a factor of pressure on historic cities, become an opportunity for the sustainability and economic viability of society when it is used in an appropriate way, without destroying or disappearing the historical heritage (UNESCO, 2011).

However, the globalization character of the landscape concept implies multiple disciplines in its total understanding, so that when we talk about integration in the urban historical landscape we have to refer to different approaches that should be addressed individually (Fernández-Baca Casares et al., 2011). It is not the object of this work to address all the dimensions offered by the cultural landscape of the cities, since we would surpass its extension and the subjects of study included in the own line of investigation in which it fits. In this way, the concept of landscape integration or integration into the urban historical landscape used during the development of this work has to be understood in an exclusively urban dimension, referring to the geography of the city and its natural environment, to its spatial relations and the functional organization of the port and the city.

#### **4. Methodology used: from the theoretical concept to the construction of indicators**

This work is the result of a process of social research whose method aims at the practical application of the acquired knowledge. It has become indispensable to translate theoretical concepts into the empirical field by transforming propositions and ideas into variables and indicators that allow measuring the reality, or what is the same, to convert the conceptual definitions into operational definitions (Cea D'Ancona, 1998).

In this process known as operationalization different stages of development are distinguished, such as the theoretical representation of the concept, the decomposition of the concept into dimensions or aspects, the selection of empirical variables or indicators for each dimension, and finally, the weighting of indicators of the same dimension (Cea D'Ancona, 1998).

Based on this process, the transition from the concept of urban integration to formulas of calculation takes place through the development of the following methodological stages.

- Review of background and compilation of information on codes and manuals of existing good practices elaborated from the study of real cases.
- Definition and theoretical delimitation of the concept of urban integration of ports.
- Selection of results obtained in the analyzed publications that conform to the port-city model.
- Critical and interpretive analysis of successful proposals and solutions elaborated from cases studied in the following selected publications:
  - Guide of good practices. Plan the city with the port. Strategies for redeveloping city-port linking spaces, a project framed in the European Union's program called Hanse Passage, in which several port cities participated together with the World Network of Cities and Ports.

- Port-city: a comparative study of good practices, edited by the Observatory of Urban Environment of the City of Málaga.
- Make the city with the port: a guide to best practices, published by the World Network of Cities and Ports.
- Reflection of the urban-port phenomenon and definition of dimensions or aspects from which to operate to obtain variables.
- In a process of deduction based on the cases studied by the manuals of good practices that have been analyzed, the variables are broken down into one or more indicators.

With the overcoming of these methodological phases, a system of indicators grouped into subsystems is obtained according to the aspect from which the operation of the concept is approached.

## 5. Port-city integration concept: model dimensions and variables

For the formulation of the indicators that more accurately and reliably measure reality has operated with the theoretical concept of urban integration of the port as it has been defined and dimensioned in previous sections. Based on the meaning of this principle, we have recognized different urban dimensions that have been concreted to be approached with more precision: urban geography and territory, spatial relations and port and city mobility, and finally, their functional relations.

### 5.1. Urban Geography and Territory

*Characteristics and transformations of the natural environment.* The natural environment in which a port is located is a factor to be taken into account in the integration possibilities of the port that intervenes in its final morphological characteristics and those of the city itself.

The enclaves considered natural ports, such as protected beaches, bays or inlets, formed by a coastline with natural features and geographic conditions, allow the shelter of boats in the calm waters without the need for large infrastructures. These interventions with docks and breakwaters for maritime protection, which are happening with the port expansions, alter the natural profile of the coast and hamper port associations with the city. In addition, the shape of the coast with incoming and outgoing land on the sea diversifies the spatial and visual relations with the city itself, which is why they are more favorable integration situations that should be reflected in the indicators that are constructed.

In these visual relations and opening of views towards the port and towards the city also influences the topographic factor, measurable based on the inclination of the land allowing the creation of spaces that enhance the image of the port.

The expansion of the ports started at the end of the s. XIX meant the beginning of a continuous process of transformations before the need to expand its limits, covered in different ways according to the territorial conditions of each city and its surroundings. These forms of occupation and growth have determined different patterns of port disposition in relation to the coast that affect in their interaction with the city. The growth towards the sea in a direction perpendicular to the coast carried out by obtaining land with landfills is the most unfavorable situation for the adaptation of the port to the city, resulting in the transfer of port activity to areas far from the urban center in dispersed and non-versatile terrain, with extensive infrastructures outside for the shelter of the docks.

The opposite scenario consists of the development of the port in line with the coast, in which its natural conditions are taken advantage of without major transformations, and in which at best, there is even growth of the city itself. is that of a lesser transformation of the coast and a port with continuous spaces, more controlled and with great possibilities of connection to the network of public spaces of the city.

The proportion of the urban coast that goes to the port functions translates into different situations that can be evaluated with the indicator that shows its influence in the interactions of the port and the city. In addition to considering the weight of the port in the city, when they have completely closed the coast and forced the urban development to the interior produce a maritime and port untying in these cities that accelerate the processes of change to reverse the situation, especially in the ample spaces that are generated of friction between the port and the city. On the other hand, when the ports are located in a small part of the coast that the city occupies, it creates environments and intermediate spaces without the necessary tension to promote actions of urban integration of the port.

*Extension and proportions of the port-city.* The so-called historic ports, or those that have not gone through a stage of expansion and specialization, maintain consolidated bonds with the present city. This correspondence between the proportions of the size of the port and those of the city is a factor that must be reflected with the necessary indicators.

The construction of these indicators has to include the degree of decoupling of the urban spaces that have the ports that present extraordinary dimensions, functioning as authentic autonomous organisms within the city, in which it is necessary habitual practices of recomposition and optimization of the space (AIVP, 2015).

It must be considered that this aspect has a greater impact in small cities in which the port comes to take full prominence in the articulation of the territory, with parts and components disconnected from the urban structure. In addition, it will have to include the influence of population size with demographic and compact values of the city, which undoubtedly contributes to the final value of urban integration.

*Morphological characteristics.* The final configuration of each port is the result of several processes of transformations and expansions marked by the needs of each economic model. The first morphological classification of the resulting facilities is that which distinguishes the maritime area, for the protection, shelter and maneuver of ships, of the land area, where the intermodal transfer of transport occurs, the evacuation of goods and locate the rest of support constructions.

The possibilities of improving the integration of the port in the city vary according to morphological parameters that relate the sea and land areas of the port, and those of the city with the city. These relations are variable for each case, mainly by factors such as the natural conditions of the coast or the functional needs of the port.

## 5.2. Spatial relations and mobility

*Configuration of the public space network.* The shape, dimensions and distribution of the elements that make up the network of public spaces are directly related to mobility and to the level of citizen participation of the uses and activities of the city, among which are those related to the port that can be integrated. These elements of the urban physical structure should be used in the transition zone of the city-port as the backbone of a space that, for different reasons, normally suffers from sufficient citizen participation, and which, with the correct configuration, would also contribute to reduce the physical barrier effect they have acquired. In short, the construction of indicators is intended to know the capacity for cohesion of the public space in the areas of measurement that are determined.

In order to be able to quantify the impact of this aspect in the first place, it is necessary to quantitatively consider the existence of the public space in the different areas of measurement. In this way, a generous port-city transition space in their recreation areas presents greater ease of use on the part of the citizen, besides serving, with the appropriate treatment, as a cushion to the most annoying port activities. In addition, there are more and more examples of port transformation that include routes for access to urban activities within the port area (Andrade Marqués and Blasco López J, 2012). In this way, in addition to articulating urban activities that are implemented in the interior of the port area, new places of encounter and stay with strong maritime ties are generated.

The continuity of this new network of port areas with the existing urban network is another aspect to be taken into account in order to avoid isolated, unconnected and unattractive places for the citizen. For this, adequate direct connections of the spaces created in the port areas with the road system and the system of green zones of the city are necessary (Jeanne and Dorbane, 2007). It is necessary to quantify the presence of continuous pedestrian routes or for non-motorized traffic, with a treatment that persuades the pedestrian to participate in these environments.

It is also possible to measure the strengthening of the transversal axis to the coast in the city's road system, in such a way as to facilitate the mobility flows directed to the interface and to the interior of the port, breaking the directionality parallel to the dominant coast in the routes of the transition zone. Thus, there are spaces with a sewing function of the urban plot with the port (Schubert, 2004), in which new urban uses can be articulated and in turn generate places of stay and encounter with space openings towards the sea.

*Physical barriers and permeability.* As a general rule, the legal limits of port facilities are materialized through the construction of fencing and walls. Within these terminals, the spatial arrangement is usually solved by attending only to its operating needs and, as the only relationship with the urban network, to the necessary connections with the terrestrial transport system. Faced with this reality can be developed indicators that offer information related to the physical elements separating and opening the port areas to the city.

To the concept of barrier that ports represent, we must add the nature of adjacent urban spaces, which are treated on multiple occasions as a transition zone without attractiveness to the citizen, as a result of the lack of consensus in the search for solutions that address to the needs of the port-city. This situation worsens when these spaces are mainly used for transport facilities, such as interurban roads and railway lines, accentuating the deterrent and psychological barrier for the citizen.

This aspect, which negatively affects spatial continuity and urban mobility, is considered to be one of the most influential for the integration of the port into the city. Their evaluation is based on the use of

indicators that quantify the concentration of these barriers in the interface and its arrangement in relation to the port front.

*Visual perception.* The lack of acceptance by the citizen of the views provided by the port is a symptom of the lack of unity that the port and city lack. However, the traditional landscape cut by cranes, tanks and stacked containers, a scene of the frenetic activity that takes place in the ports, even the noises and odors in the appropriate levels, are part of the collective imagination, the port vocation of the city.

Citizenship must recognize its essential features in the image it perceives of the port, and for this there are measures, many of which exceed the limits of this work. Along with the most basic geographic variables such as the coastline or slope of the terrain that have already been exposed in the previous sections, tools can be used to configure the public space to promote the generation of views not only towards the sea, being their results measurable with the construction of the necessary indicators.

The value of this variable can be determined by measuring pedestrian routes or non-motorized traffic with a view to this port heritage, or with the extension of meeting and living areas of people with direct views of the landscape offered by the port. Another measure is related to the elimination of physical barriers that allow the visual opening of the port and in cases where the management of the port's activities prevents it, the landscape treatment of this fence in the search for greater visibility could be quantified with its own indicator.

This familiarity of the presence of the port facilities in the urban views must be accompanied by the careful design of the infrastructures, the architectural quality of their buildings and the use of materials and finishes visually attractive. The care of these aspects, including the use of other techniques such as the use of artificial lighting, highlights the living port heritage within the city usually conceived as a degraded landscape. The construction of indicators to measure the results of these measures presents some complexity for their accuracy, which will have to be solved with measurable variables by categories adopted based on the perception of urban reality itself.

*Sustainable mobility.* For the port facilities and their transitional urban areas, it is a challenge to reach a balance and resolve the conflicts that are created between the mobility of the goods that exchange the mode of transportation and the urban displacements of the population.

The transformation of uses and activities in the intermediate spaces of the port with the implementation of services and facilities that the citizen can access in coexistence with the functions of the port, requires improving the conditions of mobility and accessibility to these spaces, which despite of their centrality in most cases, generally present severe accessibility deficits for the population (Schubert, 2004).

To this must be added the incorporation of new uses and urban services inside the port facilities, which demands solutions that make accessible and nearby places further away and usually unexplored by public transport systems.

In these areas, especially those that have already undergone transformation processes, it is common for the public transport system to go further with less usual proposals such as the use of inland waterways (AIVP, 2015), which, in addition to the remaining alternatives reinforces links with the port and opens new communication channels at sea, with new opportunities for the creation of unknown views of the city and its port heritage.

The option of private motorized traffic, although less favorable to the sustainability of the model, has to be evaluated to the extent that it allows the easy parking of vehicles by the existence of sufficient parking spaces, if possible in the subsoil and in buildings of uses mixed, as we will see in the following sections. Faced with the congestion problems presented by this option, the other alternatives have to pass through more environmentally friendly modes of transport that expand the range of possibilities of each social stratum. These forms of displacement have a positive impact on the urban integration of port areas; the creation of indicators gives us the possibility of quantifying and assessing the fulfillment of expectations.

In short, the forms of measurement of the urban mobility conditions to be considered are multiple. At a minimum, the quantification of a road network with minimum spatial conditions for pedestrian use is indispensable; the influence of public transport, whether terrestrial or maritime, measured with the maximum accessible distance of stops; and the existence of the bike lane in its case, according to the percentage covered of the main routes. All this without neglecting the use of indicators that show the satisfied space demand for the parking of private vehicles off the road.

### **5.3. Functional relations**

*Management of port facilities.* The distribution of the facilities of a port is the feature that best represents the integration criteria of the model that has been conceptualized, whose ideal situation is the greater possible interaction of the port with the city through the coexistence of urban uses and port functions. The inconveniences of legal and environmental character known in port-city relations

(Sánchez Pavón, 2003) make it difficult to achieve total communion in this sense, however, acceptable levels of integration can be achieved through the zoning of the port facilities and its relation with the spaces of the city.

The distribution of the port's functions and its spatial and visual relationship with the uses of the city can be evaluated with indicators on the aspects that reflect the degree of repercussion in the integration model. From the extensive experience in reconversion of port fronts, the uses, with or without port connection, are best known in these environments (López Amil C, 2004). However, since the analysis of complete port areas is intended, whether they have been reconverted or not, it is necessary to include among the variables all port activities in relation to the distribution of uses of the city.

Generally speaking, the proximity to housing and industrial areas should be positively valued of the facilities with the port's own uses (commercial, fishing and nautical sports) as opposed to the activities of its annexed industries that are more difficult to reconcile (shipyards, refineries, ..). Taking into account the main functions of the port, the nautical-sport practice is admitted successfully in the vicinity of the city in front of the activities of the commerce and the fishing. Passenger traffic, with space and technical requirements more adaptable to the urban environment, is preferable to freight traffic. As for the manipulation of these, priority should be given to those related to small cargoes or to traditional fishing in the face of functions that are responsible for larger volumes, bulk goods or containers in large terminals, with worse conditions of urban conciliation.

In short, with this variable it is intended to quantify with appropriate indicators the incidence that the location and main function of port facilities have in urban integration.

*Port functionality.* The different levels of traffic intensity that converge in a port produce different spatial and technical requirements for an efficient development of its transport operations. These variations in flows result in modifications and improvements to port facilities that do not always occur in a timely manner. It is usual to have areas of the port that have been forgotten due to their dysfunctionality and lack of resilience pending the reconversion, or of buildings and constructions in an advanced state of degradation inside the port. This dynamic in the activity of the ports is a variable that depends even on macroeconomic determinants that cannot be approached in this work, and which knowingly influence the efficiency of the facilities. However, common practices are known for numerous cases studied that can modify the values of the indicators that are proposed later to know this reality (Jeanne and Dorbane, 2007).

*Mixture of uses.* The port-city balance of the model proposed requires port areas in which there is a natural coexistence between uses of the different areas. There are environmental and legal constraints that limit the coexistence of any uses; however, after knowing the results in ports across the geography, there are contrasted measures that generate scenarios with a high degree of compatibility.

Measurements of this variable should be aimed at obtaining data according to the incorporation of two main destinations: public port space for leisure and recreation of the citizen and port buildings where urban services and facilities can be implemented.

The needs for cargo storage and maneuverability at ports require large work areas which, for the city, may in many cases be attractive for their relationships with the sea, and in others for their urban centrality. Proposals such as the sectorization of docks that allow public access, or even their use according to a schedule control, enrich the options of the public space of the city, while helping to strengthen the identification of citizens with the port enhancing the views of the city. port landscape

With a view to the main objective of consolidating the active port in the city, it is preferable a living port heritage in which the buildings that are part of the facilities maintain their maritime ties by the very function they perform. This should not be an obstacle to promoting the mix with other urban facilities. This mixture of uses, horizontal or vertical, in the port constructions, is a practice that has been applied in different cases studied (Jeanne and Dorbane, 2007), as in the terminals for passengers with commercial areas or in warehouses with public car parks, with more than acceptable results.

However, the obsolescence and eventual abandonment of other buildings with no opportunity for recovery to the port is usual in many cases, a situation that must be taken advantage of to introduce other additional needs of the city, preferably related to the sea and the port, with to improve the joint functional organization of the city without detracting from that of the port.

Although these actions do not favor the functions of the port, which in any case must prevail (Andrade Marqués and Blasco López J, 2012), taking the city to the port at specific times, even to the docking lines, contributes to improve the combinations of uses that the urban integration of the port requires.

This functional mixture can be extended to the maritime zone of the ports. There are practices consensual in manuals and publications of experts, applied in real cases, on the opportunity to implement uses and activities, at least partially, in the docks of the maritime area of the ports (AIVP, 2015). In these cases, the limitations are even greater, but this possibility and its valuation should not be ignored through the appropriate indicators. These activities that can be developed on the water involve the generation of new spaces and the discovery of an unknown image of the city and its port.



## 6. Results

The proposed indicators are shown below in the following tables, grouped into three subsystems corresponding to the different dimensions from which the concept of urban integration has been approached.

The mode of occupation of the territory, the dimensions and proportions of the port and the city, and the disposition that has acquired by the succession of reforms and extensions in relation to the physical structure of the city are the possible variables that define the concept of urban integration according to the urban geography and the territory. From these variables the indicators shown in Table 1 are deduced.

**Table 1** Subsystem of indicators related to urban geography and territory

VARIABLES	INDICATORS	
	Name	Description
Characteristics and transformations of the natural environment	Coastal morphology	Coastline layout
	Elevation of the terrain	Elevation of the terrain
	Coastline transformation	Relation of the length of coast occupied by the port with the average distance from the maritime border
	Pressure of the port on the coast	Proportion of the urban coastline occupied by the port
Extension and proportions of the port-city	Surface ratio	Relation of the surface of the port with the surface of the city
	Demographic proportion	Relation of the surface of the port with the population of the city
Morphological characteristics	Pressure of the terrestrial zone	Surface unit of the terrestrial zone for each linear meter of port edge
	Weight of the maritime zone	Surface relation of the maritime zone with the terrestrial zone

The indicators presented in Table 2 correspond to the spatial dimension of the phenomenon of integration of the ports, delimited from three variables that inform about the configuration of the spaces, their permeability, the physical barriers, the staging of the image of the port and mobility.

**Table 2** Subsystem of indicators in the field of spatial relations and mobility

VARIABLES	INDICATORS	
	Name	Description
Configuration of the network of public spaces	Concentration of public spaces	Percentage of soil that forms part of the urban and port network of public spaces
	Space continuity	Percentage of the urban front with expanded vials in the port area
	Transversality and visual openings	Percentage of public space with visual openings to the sea
Physical barriers and spatial permeability	Physical separations	Percentage of the unpaved port boundary accessible from the city
	Disposal of land transport facilities	Percentage of the port area occupied by interurban and rail traffic
	Surface concentration of transport facilities	Percentage of transition zone occupied by interurban and rail traffic routes
Visual perception	Tours and port perspective	Length of footpaths that enhance the image of the port
	Port mirrors	Surface of spaces for the stay of people that enhance the image of the port
	Architectural quality	Existence of architectural symbols and artistic treatment of infrastructures
	Urban design	Treatment in the finishes and equipment in the elements of urbanization
	Landscape treatment of barriers	Care in the use of materials that allows greater transparency and visibility to the port from the city
Sustainable mobility	Pedestrian routes	Percentage of public space destined for continuous and accessible pedestrian paths (width > 5 m)
	Public transport	Percentage of soil within the circle of influence of TP, radius 300 m
	Presence of bicycle lane	Percentage of public space destined for bicycle lane
	Car parks	Percentage of demand that is covered with off-road parking spaces

The third aspect considered from which the joint reality of the port and the city has been approached is the distribution and relation of its uses and activities. Table 3 shows the indicators defined based on the characteristics related to the organization of the port facilities, their functionality and the combination with other urban uses.

**Table 3** Subsystem of indicators of the scope of functional relations

VARIABLES	INDICATORS	
	Name	Description
Organization of port facilities	Distribution of freight exchange areas in the port	Relation between the surface of freight facilities and distance to the city
	Distribution of exchange areas of the passage in the port	Relationship between the surface of the passenger traffic facilities and the distance to the city
	Distribution of annexed industries in the port	Relation between the surface of the annexed industries and the distance to the city
	Distribution of the complementary facilities	Relation between the surface of the complementary facilities of urban character (nautical ports, sailboats, sports, industrial estates) and the distance to the city
Functionality of the port	Functional obsolescence of the space	Percentage of the surface without use or port function
	Building degradation	Percentage of floor area occupied by abandoned buildings
Mixture of uses	Spaces with mixed uses	Percentage of the surface of open spaces shared by urban and port uses
	Buildings with mixed uses	Percentage of the constructed surface of the buildings in which urban and port uses coexist
	Urban uses on the coast	Percentage of berthing lines where the port functions are combined with other urban uses
	Sheltered waters shared with urban activities	Area of the sea area where non-port activities are permitted
	Floating urban facilities	Surface of floating equipment

## 7. Conclusions

The complexity of the notion of urban integration of the maritime port heritage and the different approaches from which to approach the idea of constituting a joint urban-port reality make it difficult to obtain reliable tools for its measurement. It has been necessary an exhaustive conceptual delimitation more operative from the review of the antecedents and the published case studies, with which the different dimensions from which to approach the integration model have been distinguished. Based on the three defined dimensions, we have been able to detect the variables and indicators that can bring to the empirical field the theoretical propositions of the concept.

The results obtained serve as the basis for the development of a novel tool that may allow the analysis of the processes of conversion of urban-port systems and the measurement of the degree of acceptance according to the defined integration model. However, this proposed system of indicators is a first step towards the development of fact sheets with more exhaustive information on each indicator, including the concrete definition, methodology for its calculation and the parameters of its evaluation, pending development in later phases of the investigation.

In short, this work contributes to the knowledge about the empirical analysis of urban-port relations, with a starting scheme of a methodology applicable to different scenarios to quantify current situations, and based on the objectives that are marked, change trends.

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